

Claims

1. An electrical apparatus having a cooling system, the apparatus comprising:
- 5 a first cover defining an enclosure for housing part of the electrical apparatus to be cooled;
- a second cover substantially enclosing the first cover to define a surrounding space therebetween, the surrounding space having an inlet and an outlet;
- 10 first circulation means for causing air to circulate in the enclosure; and
- second circulation means for causing a cooling fluid to circulate around the surrounding space between the first and second cover;
- 15 heat transfer means between the enclosure and the surrounding space, such that heat is transferred from the enclosure to the cooling fluid in the surrounding space and out of the outlet; and
- a base plate on which the first cover is mounted,
- 20 the base plate having one or more apertures communicating with the surrounding space; and
- wherein the second circulation means are arranged outside of the surrounding space, such that there is a flow of cooling fluid adjacent the enclosure, through
- 25 the one or more apertures and through the surrounding space.
2. An electrical apparatus according to claim 1, wherein the base plate and the first cover together
- 30 define the enclosure for the electronic apparatus, and wherein the cooling system comprises a heat exchange structure disposed on the base plate outside the enclosure in the flow of cooling fluid.

3. An electrical apparatus according to claim 1 or 2, wherein the second circulation means comprise one or more fans mounted on the base plate.
- 5 4. An electrical apparatus according to any preceding claim, comprising a restriction in the flow of cooling fluid in the region of the apertures, such that fluid pressure forces cooling fluid through the apertures.
- 10 5. An electrical apparatus according to claim 4, wherein the restriction comprises a heat transfer structure.
6. An electrical apparatus according to any preceding
15 claim, comprising:
a partition defining an enclosure for a second part of the electrical apparatus that is to be cooled, the partition being attached to the base plate; and
a heat exchange structure disposed in the flow of
20 cooling fluid and arranged to draw heat from the second part of the electrical apparatus.
7. An electrical apparatus according to claim 6, wherein the second part of the apparatus is situated on
25 the opposite side of the base plate to the first part.
8. An electrical apparatus according to claim 6 or 7, wherein the second part of the apparatus comprises a vacuum tube device.
- 30 9. An electrical apparatus according to any preceding claim, wherein the heat transfer means comprises a first heat exchange structure disposed on the inside of the first cover, within the enclosure.

10. A electrical apparatus according to any preceding claim, wherein the heat transfer means comprises a second heat exchange structure disposed on the outside
5 of the first cover, within the surrounding space.

11. An electrical apparatus according to claim 10, wherein the first and second heat exchange structures are mounted in correspondence with each other on
10 opposite sides of the first cover.

12. An electrical apparatus according to any preceding claim, comprising an internal cover mounted in the enclosure creating a circulating fluid flow path in the
15 enclosure.

13. An electrical apparatus according to claim 12, wherein the first circulation means are mounted on the internal cover.

20. 14. An electrical apparatus according to claim 12 or 13, wherein the first cover comprises a heat exchange structure on its inside surface, within the enclosure, and wherein the internal cover extends in the enclosure
25 such that the circulating fluid flow path passes through the heat exchange structure.

15. An electrical apparatus according to any preceding claim, comprising path defining means disposed in the
30 surrounding space defining a circulating path for the flow of the cooling fluid, between the apertures and an outlet.

16. An electrical apparatus according to claim 15,

wherein the path defining means comprises a ridge disposed on the first cover.

17. An electrical apparatus according to claim 15 or
5 16, wherein the path defining means constrain the cooling fluid to flow substantially over the entirety of the surface of the enclosure.
18. An electrical apparatus according to any preceding
10 claim, comprising a breather tube housed in the first surface, a chamber in communication with the breather tube and with the enclosure, and a desiccant material located in the chamber.
- 15 19. An electrical apparatus according to any preceding claim, having a fluid inlet and a fluid outlet in communication with the surrounding space.
20. An electrical apparatus according to any preceding
20 claim, wherein the cooling fluid is air.
21. An electrical apparatus according to any preceding claim, wherein the first cover is metal.
22. An electrical apparatus according to any preceding
25 claim, wherein the second cover is a plastic material.
23. An electrical apparatus according to any preceding claim, wherein the first and second cover have smoothed
30 corners.
24. An electrical apparatus according of any preceding claim, wherein the outlet joins the fluid flow path

adjacent the enclosure.

25. A high power radio frequency amplifier comprising the electrical apparatus of any preceding claim.

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26. A satellite uplink amplifier comprising the electrical apparatus of any of claims 1 to 25.